SBIR/STTR Program Overview

C. PROGRAM OVERVIEW

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs are Government-wide programs authorized under Section 9 of the Small Business Act (15 U.S.C. § 638). The objectives of the SBIR program are to (1) stimulate technological innovation in the private sector, (2) strengthen the role of Small Business Concerns in meeting Federal R&D needs, (3) increase private sector commercialization of innovations derived from Federal R&D activities, (4) foster and encourage participation by socially and economically disadvantaged and women-owned Small Business Concerns, and (5) improve the return on investment from Federally funded research and economic benefits to the Nation. The objective of the STTR program is to stimulate cooperative partnerships of ideas and technologies between Small Business Concerns and partnering Research Institutions through Federally funded R&D activities.[1]

ARPA-E administers a joint SBIR/STTR program in accordance with the Small Business Act and the SBIR and STTR Policy Directives issued by the U.S. Small Business Administration (SBA).[2] ARPA-E provides SBIR/STTR funding in three phases (Phase I, Phase II, and Phase IIS).

D. PROGRAM BACKGROUND

This program seeks to fund the development of transformational technologies that reduce the barriers to mass adoption of electrical energy storage for stationary and transportation applications.

1. STATIONARY

Emerging challenges in integrating renewable generation and highly variable loads with the existing electrical grid has motivated the development of low-cost stationary energy storage technology which could transform the U.S. electric power grid industry.[3] Electric energy storage separates generation capacity and variable demand in space and time, with potential applications ranging from long-duration bulk energy storage to short-duration power quality and frequency regulation balancing.[4] Traditionally, electric energy storage was developed to increase base-load demand by shifting bulk energy produced when loads are low at night to when demand is high during the day. The incumbent technology for storage is pumped hydropower, which increases generation asset utilization from base-load resources, such as nuclear or coal generators. New opportunities for the application of electrical energy storage have emerged with the high-penetration variable non-dispatchable renewable generation sources such as wind and solar, and changes in distribution feeder load profiles, for example local clusters of high-throughput electric vehicle charging stations. In addition, the increase in deployment of distributed renewable generation enabled by low-cost photovoltaics creates a potential need for storage resources at the perimeter of the grid, including low-cost storage on the consumer side of the meter to convert intermittent distributed generation assets into reliable low-cost power and to avoid peak loads on the centralized grid.

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[1] Research Institutions include FFRDCs, nonprofit educational institutions, and other nonprofit research organizations owned and operated exclusively for scientific purposes. Eligible Research Institutions must maintain a place of business in the United States, operate primarily in the United States, or make a significant contribution to the U.S. economy through the payment of taxes or use of American products, materials, or labor.

[2] See 67 Fed. Reg. 60072 (Sept. 24, 2002); 70 Fed. Reg. 74926 (Dec. 16, 2005).

[3] Boston Consulting Group, "Revisiting Energy Storage: There is a Business Case" (2011), www.bcg.com/documents/file72092.pdf.

[4] Electric Power Research Institute, "Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs and Benefits", Product ID: 1020676 (2010), www.epri.com.

In 2010, the Advanced Research Projects Agency-Energy (ARPA-E) initiated the Gridscale Rampable Intermittent Dispatchable Storage (GRIDS) program to specifically focus on the development of transformational approaches to low-cost, scalable, high-capacity storage technologies that, if successful, have the potential to meet requirements for regulating reserve capacity relative to intermittent power ramp events on the grid.[5] Since this time, new scientific advances have been reported that may enable use-driven research and development towards the ubiquitous deployment of low-cost stationary energy storage systems.[6] In addition, issues related to the high-penetration of renewable resources in specific regions of the U.S. power grid have become a serious consideration, potentially limiting the ability to add additional renewable generation assets.[7] This research and development funding announcement is motivated by both new, use-driven research opportunities derived from technical requirements contained in the previous GRIDS solicitation and the emergence of new challenges for the electric grid.

The specific new opportunities in stationary storage presented in this solicitation are

(1) Low-cost storage for electric distribution systems supporting high local-penetration of electric vehicles (EVs) with high-throughput charging demands; and

(2) Low cost storage for both residential and commercial customer-side of the meter applications.

2. TRANSPORTATION

The widespread deployment of cost-effective electrified light-duty vehicles represents a tremendous opportunity for dramatic reductions in U.S. oil imports by shifting the U.S. transportation energy supply from petroleum to electricity. I 2008, the transportation sector alone represented 70% of all U.S. petroleum consumption, 57% of which came from foreign sources. At the same time, nearly 95% of the nation's transportation energy came from petroleum, with light duty vehicles accounting for more than 60% of this total.[8]

In addition to economic benefits, electric vehicles have the potential to dramatically reduce greenhouse gas emissions. The U.S. transportation sector is the single greatest contributor to the nation's greenhouse gas emissions, accounting for ~ 30% of all U.S. carbon dioxide emissions.[9] On a well-to wheel basis, electric vehicles produce ~ 38% less CO2emissions than gasoline-powered vehicles, assuming the national average for electrical energy sources (50%coal, 18% gas, and 3% oil).[10] Further reductions in CO2 emissions are anticipated from electric vehicle adoption as the U.S. electrical grid continues to decarbonize.

In order to realize the economic and environmental benefits of wide-spread electric vehicle adoption, batteries should provide for a driving range of at least 300 miles on a single charge and be competitively priced with conventional gasoline powered vehicles. Today's commercially available lithium-ion batteries for electric vehicles have an energy density and cost of about 120 Wh/kg and 500 $/kWh, respectively, at the pack-level, or about 200 Wh/kg and 300 $/kWh at the cell level. At these levels, a battery pack that can deliver sufficient energy for a 300 mile range (85 kWh) would cost roughly

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[5] Gridscale Rampable Intermittent Dispatchable Storage (GRIDS) program FOA, arpa-e-foa.energy.gov/Default.aspx?Archive=1.

[6] Pratt, H.D., Alyssa, J.R., Staiger, C.L., Ingersoll, D., Anderson, T.M., 40 DALTON TRANSACTIONS 11396-11401 (2011); Wessels, C.D., Huggins, R.A., Cui, Y. 2 Nature Communications 550 (Nov. 22 2011).

[7] Kamath, C., Transmission and Distribution Conference and Exposition, 2010 IEEE PES (2011).

[8] U.S. Department of Energy, Energy Information Agency, http://www.eia.doe.gov.

[9] "Inventory of Greenhouse Gas Emissions and Sinks: 1990-2007", Environmental Protection Agency, Report No: EPA 430-R-09-004 (2009).

[10] U.S. Department of Energy, Advanced Fuels & Advanced Vehicles Data Center, "Emissions from Hybrid and Plub-In Electric Vehicles" (2011), http://www.afdc.energy.gov/afdc/vehicles/electric_emissions.php.

$40,000.[11] Widespread adoption of electric vehicles will require battery cells with more than double current state of the art energy densities (> 400 Wh/kg) at a third the cost (< 100 $/kWh). Despite recent progress in both cost and performance, chemistry-based energy density limitations may prevent current lithium-ion battery technology from achieving these goals.

In this Small Business Innovation Research (SBIR) Funding Opportunity Announcement (FOA), ARPA-E seeks to fun the development of a new generation of ultra-high energy density, low-cost battery technologies capable of providing sufficient performance and cost to enable the widespread deployment of all-electric, long-range vehicles.
The ambitious targets for this FOA are largely based upon the long term electric vehicle (EV) battery goals set by the United States Advanced Battery Consortium (USABC).[12] ARPA-E seeks to fund high risk, high reward research efforts that, if successful, will have a transformational impact on the rate and scale of deployment of all-electric, long-range vehicles.

The specific new opportunities in automotive storage presented in this solicitation are:

(1) New battery chemistries;

(2) New battery architectures; and

(3) Novel electric storage systems.

E. PROGRAM OBJECTIVES

1. STATIONARY

This solicitation is focused on two emerging research areas for low-cost stationary energy storage: (1) low-cost, grid-scale storage, particularly for electric distribution systems supporting high local-penetration of electric vehicles with high-rate charging demands and (2) low-cost storage for consumer-side of the meter applications. Cost, round-trip efficiency, scalability, safety, and reliability are key drivers for any energy storage technology used for the electrical power grid. Additional considerations include issues such as power and energy density, depending on the specific intended application. All other technical attributes being equal, the lowest cost solution is obviously preferred for stationary applications, providing optimal consumer value under a given regulatory environment and the shortest investment recovery time. In addition, storage technologies must compete with non-storage solutions with similar electrical resource attributes, such as distributed generation or demand response. Consequently, energy and power costs for a new storage technology must have the potential to be less expensive than non-storage alternatives in order to achieve market adoption. Particularly in a small-business framework, consideration of transformational new storage technologies must present a low-cost pathway in order to ultimately have disruptive impact on the electrical power system.

2. TRANSPORTATION

This opportunity is focused on the development of advanced electrical energy storage systems with the potential to provide electrical energy storage for vehicles with cell-level specific and volumetric energy densities exceeding 400 Wh/kg and 600 Wh/L, respectively, and with an electrode materials cost under $50/kWh. The ability for proposed battery technologies to achieve target metrics on a number of other key performance parameters (detailed below) is of

[11] Based on ARPA-E calculations using data from Tesla Motors, http://www.teslamotors.com/models/options

[12] United States Council on Automotive Research, United States Advanced Battery Consortium (USABC), "USABC Goals for Advanced Batteries for EVs," http://www.uscar.org/guest/tlc/3/Energy-Storage-TLC.

significance, but of secondary importance. New battery chemistries with high theoretical energy densities are of particular interest for this funding opportunity. The development of traditional lithium-ion based batteries using carbon-based anodes with lithium metal oxide intercalation cathodes ($LiMxOy$, where M = V, Ni, Co, Mn, FeP) are not of interest because other U.S. battery research and development programs[13] are actively engaged in their development.

F. TECHNICAL CATEGORIES OF INTEREST

This program is focused on supporting the development of breakthrough solutions in electrical energy storage for stationary and transportation applications. Research and development projects that address the Primary and Secondary Technical Targets described in Section I.F of the FOA are encouraged. ARPA-E will accept applications that provide a well-justified, realistic potential of meeting or exceeding all of the Primary and Secondary Technical Targets. Favorable consideration will be given to applicants who show they can meet or exceed all Primary Technical Targets within the time frame of the award for the following area of interest categories:

1. CATEGORY 1: RAMPABLE INTERMITTENT DISPATCHABLE STORAGE TECHNOLOGIES

The following topics are of particular interest for this category:

- Investigation of technologies with the potential to achieve extremely low cost and high scalability stationary energy storage for deployment on the electric power grid. Such technologies might include, but are not limited to: batteries, flow-batteries, flywheels, superconductors, supercapacitors and compressed air systems;

- Investigation of new materials or component level approaches to membrane assemblies, long lifetime electrodes, high energy density electrolytes, safe and reliable chemistries and high critical current density superconductors, which if successfully developed would provide breakthrough capabilities in energy storage systems. For such investigation, researchers who might be working on sub-system materials or component level innovations are highly encouraged to partner with energy storage system technologists as a means of evaluating system level functionality resulting from breakthroughs in the proposed effort.

- Electric energy storage technologies based on new chemistries or physical properties not previously supported by ARPA-E or previously developed for commercial application;

- Technologies which have the potential to greatly exceed one or more primary technical targets; and

- Technologies with the potential to provide power ramp support needed as a result of a high local penetration of electric vehicle charging demand (particularly for fast charging stations) on the distribution grid are of particular interest.

The following topics are specifically not of interest for this category under this FOA (see Section I.H of the FOA):

- Technologies that do not store energy in a manner compatible with returning it to the power grid on an efficient energy-in to energy-out (electric) basis.

- Thermal energy storage that does not provide a technical pathway for electrical energy-in to electrical energy-out.

[13] U.S. Department of Energy, Office of Vehicle Technologies, Energy Storage, Batteries, http://www1.eere.energy.gov/vehiclesandfuels/technologies/energystorage/batteries.html; see also U.S. Advanced Battery Consortium, http://www.uscar.org/guest/teams/12/U-S-Advanced-Battery-Consortium.

- Electrical battery management systems, unless connected specifically to a proposed energy storage mechanism for control.
- Approaches for the hybridization of two or more energy storage technologies as a system through advanced battery management systems.
- Simulations or computer models of energy storage systems which do not include innovation related to any specific energy storage mechanisms.

2. CATEGORY 2: STORAGE TECHNOLOGIES FOR UBIQUITOUS DEPLOYMENT BY CUSTOMERS

The following topics are of particular interest for this category:

- Investigation of stationary energy storage technologies with the potential for deployment in small, modular, extremely low-cost units on electric customer locations. Such technologies might include, but are not limited to: batteries, flow-batteries, flywheels, superconductors, supercapacitors and compressed air systems;
- Investigation of new materials or component level approaches to membrane assemblies, long lifetime electrodes, high energy density electrolytes, safe and reliable chemistries and high critical current density superconductors, which if successfully developed would provide breakthrough capabilities in energy storage systems. For such investigation, researchers are highly encouraged to partner with potential energy storage system technologists as a means of evaluating system level functionality resulting from component or materials level breakthroughs in the proposed effort.
- Electric energy storage technologies based on new chemistries or physical properties not previously supported by ARPA-E or previously developed for potential commercial application; and
- Technologies capable of providing more than one electrical energy storage attribute, for example renewable energy firming and frequency regulation.

The following topics are <u>specifically not of interest</u> for this category under this FOA (see Section I.H of the FOA):

- Technologies that do not store energy in a manner which has a capacity for returning it to the electric power grid on an efficient power-in to power-out (electric) basis.
- Thermal energy storage which does not provide a technical pathway for electrical power-in to electrical power-out (electric) as a system.
- Electrical battery management system, unless connected specifically to a proposed energy storage mechanism being controlled.
- Approaches for the hybridization of two or more energy storage technologies as a system through advanced battery management systems.
- Simulations or computer models of energy storage systems which do not include innovation related to any specific energy storage mechanisms.

3. CATEGORY 3: HIGH ENERGY DENSITY ELECTRICAL ENERGY STORAGE FOR TRANSPORTATION

The following topics are of particular interest for this category:

- Non-lithium based battery chemistries, including Al, Mg, and F-ion approaches with the potential for high energy density, low cost, and long cycle life;
- Metal-air battery approaches that address the low cycle life, power density, and round-trip efficiency of current approaches; especially related to improvements in bifunctional air cathodes;
- Novel battery architectures, including 3D batteries that address cell shorting and scale-up issues of current approaches;
- New electrolytes, such as solid state ion conductors or ionic liquids with enhanced chemical and electrochemical stability and high rate capability;
- Metal-sulfur battery approaches that address the low cycle life and high self-discharge of existing state-of-the-art technology;
- Advanced lithium-ion based battery systems that greatly exceed the energy density of existing traditional lithium-ion based systems, including displacement reaction cathodes and advanced anode chemistries; and
- Other novel electrical energy storage approaches with potential for very high energy density and low cost.

The following topics are specifically not of interest for this category under this FOA (see Section I.H of the FOA):

- Electrical battery management system, unless connected specifically to a proposed energy storage mechanism being controlled.
- Approaches for the hybridization of two or more energy storage technologies as a system through advanced battery management systems.
- Simulations or computer models of energy storage systems which do not include innovation related to any specific energy storage mechanisms.

G. TECHNICAL PERFORMANCE TARGETS

1. CATEGORY 1: RAMPABLE INTERMITTENT DISPATCHABLE STORAGE TECHNOLOGIES

New technologies with the potential to meet, or significantly exceed the primary and secondary technical targets of the GRIDS program are of high interest. Two areas of particular interest are (1) newly developed phenomena or scientific understanding that, if successfully developed, would provide a new technical pathway to meeting the targets, or (2) adjacent or subsequent technical challenges that would move emergent scientific approaches towards disruptive impact opportunities. Such adjacent or subsequent technical challenges might include innovative balance of plant components for the scalable development of technologies showing initial promise, but for which there remains too much technical uncertainty for private sector support.

PRIMARY TECHNICAL TARGETS

ID	Category	Value (Units)
1.1.1	System capital cost, per unit rated energy capacity at rated power	< $100/kWh
1.1.2	Operating time at rated power (at rated power for charge or discharge)	1 hr, minimum
1.1.3	Response time, to rated power (change from 0% to 100% rated power, charge or discharge)	10 minutes, maximum
1.1.4	Rated power, charge or discharge in systems demonstration prototype	>2 0 kW, (subsequently scalable to > 1MW)
1.1.5	Round trip efficiency	> 80%
1.1.6	Cycle life	> 5000 cycles

SECONDARY TECHNICAL TARGETS

ID	Category	Value (Units)
1.2.1	Scalability	Potential for subsequent scaling to grid-scale deployment (1-10 MW), assessed at
1.2.2	Calendar life	10 year minimum
1.2.3	Internal losses	<5% loss per 24 hrs from fully charged
1.2.4	Safety	Consistent with transmission and distribution grid deployment at unattended locations.
1.2.5	Dwell time	Maximum 10 minutes for reversal between charge and discharge cycles.
1.2.6	Interoperability	Interface with Smart Grid Interoperability Panel standards for storage assets.

ARPA-E will not select projects for award that do not clearly demonstrate realistic, well justified potential to meet or exceed the Primary Technical Requirements. With regard to Primary Technical Requirement 1.1.1 (system level capital cost), ARPA-E understands that small business applicants may not have access to sophisticated energy storage systems cost modeling. Still, it is expected that applicants will make a strong effort to justify how the technology holds promise to meet the $100/kWh cost target. The cost target is intended to be a forward looking consideration of energy storage system costs, including power conditioning system and balance of plant, assuming successful technology development as an advanced prototype, and subsequent scaling of manufacturing for grid-scale deployment.

2. CATEGORY 2: STORAGE TECHNOLOGIES FOR UBIQUITOUS DEPLOYMENT BY CUSTOMERS

The vision for ubiquitous energy storage deployment is based on a notional system of 2.5 kW power rating (charge or discharge) with up to 4 hr duration and a footprint equivalent to that of an appliance, such as a refrigerator, to be deployed on the consumer-side of the electricity meter as a distributed energy storage resource.[14] This system will facilitate the ubiquitous adoption of storage with a cost target of $1000, such that the capital investment would be recovered in 3-5 years through an avoidance of peak demand at a time-of-day pricing differential of $0.10 per kWh-e.[15,16] Such a storage

[14] The term "customer" may refer to deployment by either residential consumers or commercial and industrial customers of the proposed modular, small-scale energy storage technologies.

[15] ARPA-E Calculation: At $1000 for a 2.5kW / 4 hr (10kWh) storage system, at 80% round trip efficiency and 1250 cycles is $0.10 / kWh-e at full rated depth of discharge.

technology on the customer-side of the meter would provide additional attributes for balancing and firming distributed renewable generation resources, uninterruptible power supply quality services and local back-up emergency power resources. If successfully developed, the proposed customer-side of meter storage would be an alternative or compliment to community energy storage systems.[17] It is assumed that cost-effective infrastructure technologies, such as advanced metering and fault protection, will be available at a cost that enables two-way power flow and distributed electric resource integration. The small-scale (2.5 kW) system could individually support either single residence or small business energy resources. The proposed system with modular unit combined in parallel could support larger scale business, multi-unit residence or industrial applications on a cost-effective basis for energy storage and back-up power requirements.

PRIMARY TECHNICAL TARGETS

ID	Category	Value (Units)
2.1.1	Rated power (charge/discharge)	2.5 kW
2.1.2	Duration at power	4 hour minimum
2.1.3	Target cost: total system, including storage management electronics and balance of plant	$1000 per unit (ultimate target)
2.1.4	Nominal size	1.2 cubic meters[18]
2.1.5	Round trip efficiency	> 80%
2.1.6	Minimum cycle life (at rated depth of discharge)	> 1250 cycles

SECONDARY TECHNICAL TARGETS

ID	Category	Value (Units)
2.2.1	Scalability	Parallel installation functionality
2.2.2	Sustainability (Loss over time)	<2% loss in charge over 24 hrs
2.2.3	Safety	Residential and commercial indoor building code compliance for materials, construction and electrical standards.
2.2.4	Life-Cycle Durability (at rated depth of charge / discharge)	5000 cycles
2.2.5	Functionality	Multi-attribute capability (frequency regulation, bulk storage, UPS, peaking)
2.2.6	Interoperability	Smart Grid Interoperability Panel (SGIP) standards compatible
2.2.7	Installation	110V/30A 60Hz circuit or equivalent, as defined by the proposer

ARPA-E will not consider selecting projects for award that do not clearly demonstrate realistic, well justified potential to meet or exceed the Primary Technical Requirements. With regard to Primary Requirement 2.1.3, ARPA-E understands

[16] While time-of-day pricing is not a wide-spread cost structure at present, particularly for residential electricity consumers, the availability of the proposed technology would enable the deployment of such electric pricing policies for distributed electric assets. Initial markets for the proposed technology, if successfully developed, might be in small commercial and industrial applications where time-of-use pricing or similar peak charging mechanisms currently exist.

[17] Rastler, D., Kamath, H., EPRI JOURNAL (Summer 2010) 20-23.

[18] The notional footprint is 0.8m x 0.8m x 1.9m, with a mass of 150 kg such that it does not exceed typical building codes for floor loading for the complete system

that small business applicants may not have access to sophisticated energy storage systems cost modeling. It is expected that all applicants will make a strong effort to justify how the proposed technology holds promise to meet this FOA's $1000 system cost target at rated power and energy. The cost target is intended to be a forward looking consideration of energy storage system costs, including power conditioning system and balance of plant, assuming successful technology and subsequent scaling of manufacturing for ubiquitous deployment.

3. CATEGORY 3: HIGH ENERGY DENSITY ELECTRICAL ENERGY STORAGE FOR TRANSPORTATION

The final deliverable for this category is cell performance data that meets all the primary technical targets and as many secondary technical targets as technically feasible, as listed below.

PRIMARY TECHNICAL TARGETS

ID	Category	Value (Units)
3.1.1	Specific energy density	> 400 Wh/kg
3.1.2	Volumetric energy density	> 600 Wh/L
3.1.3	Electrode materials cost	< 50 $/kWh

METRIC DESCRIPTIONS – PRIMARY TECHNICAL TARGETS

3.1.1. The program target specific energy density metric is for a cell discharged at rate of C/3 to 100% depth of discharge and includes the entire mass of the cell (electrodes + electrolyte + current collectors + container). As a justification for how this metric may be achieved for a specific chemistry, applications should include anticipated positive and negative electrode half reactions, total cell reactions, equilibrium cell voltages, and theoretical specific energy densities $U_m = -nFE_{cell} / \Sigma_i M_i$, where n is the number of electrons, F the Faraday constant (26.8 Ah/mol), and $\Sigma_i M_i$ the sum of the reactant molecular weights.

3.1.2. The program target volumetric energy density metric is for a cell discharged at rate of C/3 to 100% depth of discharge and includes the geometric volume of the entire cell (electrodes + electrolyte + current collectors + container). As a justification for how this metric may be achieved for a specific chemistry, applications should include the theoretical volumetric energy density $U_v = -nFE_{cell} / \Sigma_i V_i$, where the sum of the reactant molar volumes (for metal-air batteries, the product molar volumes should be used).

3.1.3. The program targets a "realized" electrode materials cost $C_{real} = \Sigma_i w_i P_i / U_{m,D}$, where and are the mass fraction and market price of electrode component *i*, and the measured specific energy at C/3 discharge. As a justification for how this metric may be achieved for a specific chemistry, applications should include an "estimated" minimum electrode materials cost $C_{est} = \Sigma_i w_i P_i / U_m$, where is the theoretical specific energy density calculated for 3.1.1.

SECONDARY TECHNICAL TARGETS

ID	Category	Value (Units)
3.2.1	Specific power density	> 800 W/kg
3.2.2	Volumetric power density	> 1200 W/L
3.2.3	Cycle life	> 100 cycles
3.2.4	Energy efficiency	> 80%
3.2.5	Self-discharge	< 15%/mo

METRIC DESCRIPTIONS – SECONDARY TECHNICAL TARGETS

3.2.1. The specific power density targeted for the metric is obtained by discharging for duration of 30 s from a state of 80% depth of discharge and includes the entire mass of the cell (electrodes + electrolyte + current collectors + container).
3.2.2. The volumetric power density targeted for the metric is obtained by discharging for duration of 30 s from a state of 80% depth of discharge and includes the entire volume of the cell (electrodes + electrolyte + current collectors + container).

3.2.3. The cycle life target is defined by the number of charge-discharge cycles at C/3 to 80% depth of discharge until the cell degrades to 80% of its initial energy density.

3.2.4. The energy efficiency or round-trip efficiency metric is defined as the discharge energy divided by the charge energy at charge-discharge rate of C/3.

3.2.5. The self-discharge target metric is defined as a cell self-discharge rate in terms of percentage loss of initial specific energy density per month.

H. APPLICATIONS SPECIFICALLY NOT OF INTEREST

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (see Section III.F.2 of the FOA):

- Applications submitted by entities or organizations other than Small Business Concerns.

For the STTR program, applications submitted without one Research Institution as a member of the project team.

- Applications that fall outside the "Technical Categories of Interest" specified in Section I.F of the FOA, including but not limited to:
  - The projects described as "specifically not of interest" in Section I.F of the FOA.
  - Incremental improvements to lithium-ion batteries.
  - Component innovations that are not validated through demonstration of device and/or system level performance demonstration.
  - Technology areas that have already received significant support from the DOE Office of Vehicles (including its Batteries for Advanced Transportation Technologies (BATT) program) and the United States Automotive Battery Consortium.
  - Technology areas with clear technology show stoppers in any of the Primary Technical Requirements or Secondary Technical Targets that are not addressed clearly by the applicant.

- Similar applications submitted to other pending ARPA-E FOAs. (Applications submitted to this FOA must be scientifically distinct from applications submitted to other pending ARPA-E FOAs.)

- Applications for basic research aimed at discovery and fundamental knowledge generation.

- Pilot-plant demonstrations that do not include a significant degree of technical risk or requirement for scientific research.

- Applications for large-scale demonstration of existing technologies.

- Applications for proposed technologies that represent incremental improvements to, or combinations of, existing products or technologies with no additional advances in understanding or reduction in technical uncertainty, including incremental improvements to technologies previously supported by ARPA-E.

- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates a law of thermodynamics).

- Applications for proposed technologies that are not transformational, as described in Section I.A of the FOA. Transformational, as illustrated in Figure 1 in Section I.A of the FOA, is the promise of high payoff in some sector of the energy economy.

- Applications for proposed technologies that do not have the potential to become disruptive in nature, as described in Section I.A of the FOA. Technologies must be scalable such that they could be disruptive with sufficient technical progress (see Figure 1 in Section I.A of the FOA).